

CLAIMS

1. An air-refrigerant cooling apparatus comprising:
 a compressor compressing refrigerant air;
5 a heat exchanger cooling said refrigerant air
discharged from said compressor;
 an expansion turbine expanding said refrigerant
air discharged from said heat exchanger;
 a defroster removing moisture from said
10 refrigerant air discharged from said expansion turbine;
 a cooled chamber supplied with said refrigerant air
from said defroster, said refrigerant air discharged from
said cooled chamber being supplied to said compressor;
 a cooled chamber bypass pipe allowing said
15 refrigerant air discharged from said defroster to bypass
said cooled chamber and to enter a pipe connected to an
outlet of said cooled chamber; and
 a defrosting bypass pipe branched from a pipe
connected to an outlet of said compressor to supply said
20 defroster with said refrigerant air.

2. The air-refrigerant cooling apparatus according to
claim 1, further comprising:
 a heat exchanger bypass pipe bypassing said heat
25 exchanger to introduce said refrigerant from said
compressor to said expansion turbine.

3. The air-refrigerant cooling apparatus according to claim 1, further comprising:

a device measuring a pressure in said defroster.

5 4. The air-refrigerant cooling apparatus according to claim 1, further comprising:

a defroster drying mechanism exchanging moisture-including air within said defroster with external air.

10

5. The air-refrigerant cooling apparatus according to claim 4, wherein said defroster drying mechanism includes a fan discharging air within said defroster.

15 6. The air-refrigerant cooling apparatus according to claim 4, wherein said defroster drying mechanism includes:

a suction pipe disposed at a position experiencing a relatively low pressure within a pipe system provided for said air-refrigerant cooling apparatus to communicate
20 with the outside of said pipe system, and

a discharge pipe disposed at a position experiencing a relatively high pressure within said pipe system to communicate with the outside of said pipe system.

25 7. The air-refrigerant cooling apparatus comprising:
a compressor compressing refrigerant air;
a heat exchanger cooling said refrigerant air

discharged from said compressor;

an expansion turbine expanding said refrigerant
air discharged from said heat exchanger;

a defroster removing moisture from said
5 refrigerant air discharged from said expansion turbine;

a cooled chamber supplied with said refrigerant air
from said defroster, said refrigerant air discharged from
said cooled chamber being supplied to said compressor; and

a defroster drying mechanism exchanging
10 moisture-including air within said defroster with
external air.

8. The air-refrigerant cooling apparatus according to
claim 7, wherein said defroster drying mechanism includes
15 a fan discharging air within said defroster.

9. The air-refrigerant cooling apparatus according to
claim 7, wherein said defroster drying mechanism includes:
a suction pipe disposed at a position experiencing
20 a relatively low pressure within a pipe system provided
for said air-refrigerant cooling apparatus to communicate
with the outside of said pipe system, and

a discharge pipe disposed at a position
experiencing a relatively high pressure within said pipe
25 system to communicate with the outside of said pipe system.

10. A transport apparatus comprising:

an air-refrigerant cooling apparatus including:
a compressor compresses refrigerant air;
a heat exchanger cooling said refrigerant air
discharged from said compressor;

5 an expansion turbine expanding said refrigerant
air discharged from said heat exchanger;

a defroster removing moisture from said
refrigerant air discharged from said expansion turbine;

a cooled chamber supplied with said refrigerant air
10 from said defroster, said refrigerant air discharged from
said cooled chamber being supplied to said compressor;

a cooled chamber bypass pipe allowing said
refrigerant air discharged from said defroster to bypass
said cooled chamber and to enter a pipe connected to an
15 outlet of said cooled chamber; and

a defrosting bypass pipe branched from a pipe
connected to an outlet of said compressor to supply said
defroster with said refrigerant air.

20 11. A transport apparatus comprising:

an air-refrigerant cooling apparatus including:
a compressor compresses refrigerant air;
a heat exchanger cooling said refrigerant air
discharged from said compressor;

25 an expansion turbine expanding said refrigerant
air discharged from said heat exchanger;

a defroster removing moisture from said

refrigerant air discharged from said expansion turbine;
a cooled chamber supplied with said refrigerant air
from said defroster, said refrigerant air discharged from
said cooled chamber being supplied to said compressor; and
5 a defroster drying mechanism exchanging
moisture-including air within said defroster with
external air.

12. A method for operating an air-refrigerant cooling
10 apparatus including:

a compressor compressing refrigerant air;
a heat exchanger cooling said refrigerant air
discharged from said compressor;
an expansion turbine expanding said refrigerant
15 air discharged from said heat exchanger;
a defroster removing moisture from said
refrigerant air discharged from said expansion turbine;
a cooled chamber supplied with said refrigerant air
from said defroster, said refrigerant air discharged from
20 said cooled chamber being supplied to said compressor;
a cooled chamber bypass pipe allowing said
refrigerant air discharged from said defroster to bypass
said cooled chamber and to enter a pipe connected to an
outlet of said cooled chamber; and
25 a defrosting bypass pipe branched from a pipe
connected to an outlet of said compressor to supply said
defroster with said refrigerant air, said method

comprising:

placing said air-refrigerant cooling apparatus into selected one of a plurality of operation modes including a cooling operation mode for cooling said cooled chamber, and a defrosting mode for defrosting said defroster;

in response to said air-refrigerant cooling apparatus being placed into said cooling operation mode, opening valves disposed on an inlet and outlet of said cooled chamber, and closing a valve disposing in said defrosting bypass line; and

in response to said air-refrigerant cooling apparatus being placed into said defrosting operation mode, closing said valves disposed on said inlet and outlet of said cooled chamber, and opening said valve disposing in said defrosting bypass line, with a motor for driving said compressor and said expansion turbine operated at a rotational speed lower than that for said cooling operation mode.

20

13. The method according to claim 12, wherein said air-refrigerant cooling apparatus further includes a heat exchanger bypass pipe bypassing said heat exchanger to introduce said refrigerant from said compressor to said expansion turbine, and said method further comprising:

opening a valve disposed in said heat exchanger bypass pipe and closing a valve introducing said

refrigerant air discharged from said compressor into said heat exchanger, when said air-refrigerant cooling apparatus is placed into said defrosting operation mode.

- 5 14. The method according to claim 12, wherein said air-refrigerant cooling apparatus further includes a device measuring a pressure in said defroster, and said method further comprising:

switching said air-refrigerant cooling apparatus
10 from said cooling operation mode to said defrosting operation mode in response to said measured pressure.